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# An Evaluation of Municipal Recycling Programs in Massachusetts

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# An Evaluation of Municipal Recycling Programs in Massachusetts

An **Interactive Qualifying Project**
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Bachelor of Science.

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## Abstract

The effectiveness of municipal recycling programs in 350 Massachusetts towns were analyzed. The data suggest that the recycling budget in each town has a significant impact on the overall quality of the program. Affluent and well-educated towns in the western part of the state have established successful recycling programs. Implementing PAYT or single-stream recycling programs also has a positive effect on a town's municipal recycling rate.

# Table of Contents

# Executive Summary

## General Introduction

The recycling of paper, glass, metal, and plastic materials has become a significant part of recent environmental initiatives across the United States. Recycling reduces the air and water pollution that results from the manufacturing of new products, and reduces the amount of material disposed of into landfills. Recycling also decreases the amount of raw material that needs to be collected, thus saving money and resources. However, despite these economic and environmental benefits the United States does not currently have any laws mandating recycling. Massachusetts has legislations in place which give residents incentives to recycle, such as bottle bills and waste bans, but it is up to individual towns to create their own recycling programs. In 2008, 168 of the 350 towns in Massachusetts had voluntarily implemented laws which require their residents to recycle (3). This is a good start; however in 2008 the recycling rate in Massachusetts was still 32%, which is below the national average (7). Many factors contribute to the success of municipal recycling programs, both demographic as well as the type of program in place. There are several different types of recycling programs a town can implement, such as a curb-side program, PAYT, or single stream program. Demographic factors, including population, median income, and location, are not controllable by a town's government but have an impact on the local recycling rate. By studying all of these different factors, this study looked to determine what actions can be taken by towns to increase their residential recycling rates.

## Objectives

1. Collect data on current recycling practices in Massachusetts
2. Analyze both demographic data as well as types of recycling programs to determine their effects on residential recycling rates
3. Use the information collected to make suggestions on how to increase the effectiveness of municipal recycling programs

## Methodology

This study analyzed cities and towns in the commonwealth of Massachusetts from the years 1997 to 2008. Data collected for each of the 350 towns in Massachusetts included demographic information such as population, median household income, and education level, as well as information about the town's recycling program, recycling rate, and services provided. The effectiveness of a town's recycling program was determined by its residential recycling rate. This

is defined by the Massachusetts Department of Environmental Protection as the total residential tons diverted (recycled, composted, and hazardous products collected) divided by the total residential tons generated (7). By using the recycling rate to compare programs in different towns, any bias due to population or size is eliminated. Residents of Massachusetts were also surveyed about their town's recycling program as well as their individual recycling practices. The responses were used to help determine people's opinions of their town's current recycling program and any attempts to improve it. This IQP is written as a paper that will be submitted to the *Journal of Environmental Science and Technology*. The complete paper is attached in the following section.

## Journal Article

# An Evaluation of Municipal Recycling Programs in Massachusetts

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## Abstract

Recycling reduces the pollution associated with manufacturing new products, and also decreases the amount of money spent on landfills and acquiring raw materials. Despite the environmental and economic benefits, there is currently no legislation regulating recycling practices; it is up to individual towns to develop and enforce their recycling programs. This study examines factors affecting municipal recycling programs in Massachusetts. Demographic and recycling program data for the 350 towns in Massachusetts were analyzed and compared to determine what factors lead to a successful recycling program. The analysis suggests that demographics have a significant effect on the recycling rate in a town. In Massachusetts, western counties have higher average recycling rates than those counties in the east. Education and income levels also play a role; towns with higher incomes and a greater percentage of residents with Bachelor's Degrees have higher recycling rates. The type of program in place, whether it is curbside, drop-off, single-stream, or pay-as-you-throw (PAYT), also has an impact on the success of the recycling program. PAYT and single-stream systems were suggested to increase recycling rates, while the data suggests that in Massachusetts residents who live in towns with drop-off programs actually recycle more material than those in towns with curbside service. Increasing the budget for recycling programs is another possible way this study found to raise recycling rates, while at the same time increasing the revenue earned per ton of recycled material for the government. Although this study focused on Massachusetts, the inclusion of demographic data will allow these suggestions for improving recycling practices to be applied across the country.

## Introduction

There has been a growing focus on green practices in the United States, and a substantial part of these practices is the residential recycling of paper, glass, metal, and plastic materials. Recycling

reduces the air and water pollution associated with producing new products from raw materials. For example, aluminum requires 96% less energy to make from recycled cans than from bauxite, and producing recycled plastic bottles uses 76% less energy (1). In 2008, the United States recycled 83 million tons of material, which is the equivalent of removing the emissions from 33 million passenger cars (2). 83 million tons of recycled material translates into a municipal solid waste recycling rate of 33.2%, which is significantly higher than the 6.4% it was in 1960 (2). However, the amount of solid waste generated per person in one day has also increased since 1960, from 2.68 pounds per day to 4.50 in 2008 (2).

Along with being beneficial for the environment, recycling is important to the economic well being of general population as well. If the United States were to stop recycling, the disposal cost of garbage would rise significantly. Recycling saves money by reducing the amount of material that is sent to landfills, and therefore extending their lives and reducing the amount of new landfill space that needs to be purchased (3). Also, without recycling the levels of our natural resources present in the environment would disappear at a much faster rate (3). If materials such as aluminum and steel were disposed of into landfills after only one use, there would quickly not be enough raw materials in the environment to replace them. The need to constantly mine for new raw materials would directly affect consumers by raising the price of goods.

Even with increased focus on green practices in the United States, there is currently no national legislation which mandates recycling (4). This lack of regulation leaves individual states and towns to develop their own recycling programs, which has created a wide variation in the success of municipal recycling programs across the United States. In the state of Massachusetts there is also currently no law that requires residents to recycle; however legislations such as waste bans and the bottle bill help give incentives for certain materials to be recycled. Waste bans prohibit specific recyclable items such as yard waste, tires, metal, paper, and wood from being disposed of into landfills (3). The bottle bill requires that a deposit is paid on most glass, plastic, metal, and aluminum containers holding beverages when they are purchased (3). This deposit is then returned to consumers only if they return their containers to be recycled. The bottle bill in particular has been successful in Massachusetts at reducing litter and increasing the recycling rate (3).

Along with these state-wide legislations, 168 of the 350 towns in Massachusetts have voluntarily implemented mandatory recycling regulations (3). Besides these legislations, there are many factors that vary from town to town that can affect the success of their recycling programs. Some are controllable by state or local government, such as the structure of their program or the town's recycling budget, while others such as population, income, and age are uncontrollable. The purpose of this study was to understand the factors that drive this variation in recycling rates, and to reach conclusions about what towns can do to maximize the effectiveness of their municipal recycling programs.

## Methodology

This study focused on recycling programs for the cities and towns in the commonwealth of Massachusetts from the years 1997 to 2008. Available data included demographics, recycling program structures, and recycling rates and tonnages of each town, shown in Table 1. These data were collected for each of the 350 towns in Massachusetts. Town demographic data such as the total population, median age of the population, median household income, and the median price of a home were collected from City-Data.com (5). The education information was collected from the US Census Bureau (6). Recycling program data, including the recycling rates per year, the total tons recycled per year, if the town has a single stream recycling program, if the town has a Pay-As-You-Throw system, and whether the program was curbside, drop-off, or subscription were collected from the Massachusetts Department of Environmental Protection (MassDEP) (7). The revenue from recycling for individual towns was gathered from a March 2010 news release by the MassDEP (7).

In order to determine the effectiveness of a town's recycling program, the residential recycling rate of that town in a certain year is used. A town's residential recycling rate is defined by the Massachusetts Department of Environmental Protection as the total residential tons diverted (recycled, composted, and hazardous products collected) divided by the total residential tons generated (7). Using the recycling rate allows each town to be compared regardless of its size or population.

Residents across Massachusetts were also surveyed about their town's individual recycling programs. They were asked about the current residential recycling program, their satisfaction with the program and attempts to improve it, as well as their individual recycling practices. The

questions posed to the participants in the survey, the possible responses, and the percent of the participants that chose each response are shown in Appendix A. The survey was sent out distributed on Facebook and through e-mail to all students and faculty at Worcester Polytechnic Institute. In addition it was posted on each town's individual website on AmericanTowns.com from June 1, 2010 until August 1, 2010 (8). A total of 265 responses were received from residents across the state.

## Results and Discussion

The overall production of waste is a factor directly linked to recycling habits. In the United States, total municipal solid waste generation has been increasing from 8.1 million tons in 1960 to 249.6 million tons in 2008 (Figure 1). Using data from the Massachusetts Department of Environmental Protection about the tons of recyclable material collected in each town, the average tons of trash and recycling generated per household can be calculated (See equation in Appendix B). In order to better analyze profiles of towns with successful and unsuccessful recycling programs, the towns with the top ten highest average recycling rates (from 1997 to 2008) and the lowest ten average recycling rates were compared. Table 2 shows the significant differences as determined by the collected data between these two groups of towns, including the total tons generated per household. As seen in the table, towns with higher recycling rates actually generate fewer total tons of trash and recycling than those with lower recycling rates. One possible explanation for these behaviors is the higher cost of goods that are labeled as "environmentally friendly", which includes items that are easier to recycle. According to the Natural Marketing Institute's 2007 LOHAS Consumer Trends Database, 61% of people surveyed said that while they care about the environment, their purchases are determined mainly by price (9). From this same survey, only 30% of the people agreed that they would be willing to pay slightly more for a product made in an environmentally friendly way. People who live in towns with higher income levels (and therefore higher recycling rates as shown in Table 2) are most likely the ones willing to pay slightly more for these types of products, resulting in less waste produced.

The data collected show that municipal recycling rates can vary significantly even within a single state. In Massachusetts, the average recycling rate from 1997 to 2008 ranges from 7% in Hull to 70% in Southampton. Figure 2 shows the average recycling rate from 1997 to 2008 for each of

the fourteen counties in Massachusetts. On average, the counties in the western half of the state (Berkshire, Franklin, Hampshire, Hampden, and Worcester) have a recycling rate of 35%, while the counties in the eastern half have an average recycling rate of 28%. The large range in recycling rates is representative of the country as a whole, as discussed in Lockhart's study of participation rates in recycling programs in state capitals nationwide (10). Her data showed that participation rates ranged from 3.5% in Indianapolis to 87.5% in Olympia.

Other demographic data collected for each county, such as the number of towns in the county, median household income, population, and median age are shown in Appendix C. This map shows that the five western counties also have a significantly lower average town population (9,556) than the nine counties in the east (36,721). Education is also a factor that differs across the state. Information on the level of education of the population was available for 41 towns in Massachusetts. Figure 3 shows the relationship between the percentage of people over 25 in the town with a Bachelor's Degree and the average tons recycled in that town from the years 2003-2008. As the percent of people with higher education increases, so does the amount recycled in that town. These data suggest that the more educated a town's residents are, the more material they will recycle. Similar results were shown by Shikha Chetal in her study of statistical relationships between demographic factors and recycling rates (11). People who have continued their education are more likely to have learned about the environmental and economic benefits of recycling.

As discussed previously, Table 2 shows data for towns with the top ten highest average recycling rates and the lowest ten average recycling rates in Massachusetts. This table shows that the median income per household is a statistic that differs greatly between these two groups of towns. The average annual household income for the towns with highest recycling rates is $87,151, while the average for the towns with lower rates is $54,535 (Table 2). All of the income data collected was also compared based on the average household income level for Massachusetts in 2008 of $65,000. Towns with annual income levels lower than $65,000 have an average recycling rate of 29%, compared to 33% in towns with income levels above $65,000. The data in Lockhart's study also concluded that towns with higher median home values (and therefore higher incomes to afford those homes) had a higher participation rate (10). Both of these statistics suggest that a higher recycling rate is linked to a town's average annual income

level. Despite this correlation, legislators do not have direct control over income levels. Therefore towns with lower recycling rates will need to focus on the other strategies that will be discussed to improve their recycling rates.

Recently instituted pay-as-you-throw recycling programs may significantly benefit the amount of residential recycling collected by a town. A pay-as-you-throw (PAYT) recycling program is one where residents of a community are charged a fee for collection of municipal solid waste based on how much trash they throw away (12). In Massachusetts, 25% of towns have a PAYT program (Figure 4). As shown in Table 2, 8 of the 10 towns with the highest recycling rates in Massachusetts have PAYT programs, as opposed to 1 out of the bottom 10 towns. Figure 4 shows the percent of towns in each county that use a PAYT recycling program. In the western counties, on average 47% of the towns have a PAYT program, compared to only 30% per county in the east. As mentioned earlier, western counties also have higher average recycling rates. Also seen in Figure 4, Massachusetts has a higher average percentage of towns with PAYT programs than the average of the US as a whole. However, Figure 2 shows that Massachusetts has a slightly lower average recycling rate (32%) than the United States average (33.2%), suggesting that PAYT programs are not the only factors that make a successful recycling program. Figure 5 shows the average tons recycled per household in each county with towns that use PAYT programs. In 7 out of the 11 counties in Massachusetts with towns that use PAYT programs, these towns recycle more per household than towns that do not have a PAYT program in place. In the western counties this is less true, where only Hampden's towns with PAYT programs recycle more tons per household, but it is true for each of the 6 eastern counties with towns that use this type of program. As stated earlier, Massachusetts towns in eastern counties have significantly higher average populations than towns in western counties. These data suggest that PAYT programs result in higher average tons recycled per household in towns with higher populations.

Pay-as-you-throw programs incentivize people to produce less waste and recycle more, because this means they will pay less. In the survey posed to Massachusetts residents, 32% of people who pay for trash bags from their town said they pay $1.00 to $1.50 (Appendix A). Another question asked in this survey was about the number of trash bags people use per week on average, and 36% of participants responded that they use one large trash bag per week (Appendix A). From

this information, on average people who live in towns with PAYT programs pay $52 to $78 per year for their trash. PAYT programs provide a significant incentive to recycle because the more they recycle, the more this total cost will decrease. Having cost directly connected to recycling habits leads to a better public understanding of waste management costs, because the residents of the town are paying those costs. These programs also lead to an increase in material recovered by the town's recycling program (13).

Another possible option for municipal recycling programs is to implement a single stream system. Single stream recycling programs do not require residents to sort their recyclables by material, which makes recycling much simpler. In Massachusetts, towns have only recently begun to switch to single stream recycling systems. In 2010, 40 towns had implemented these systems, which equates to 11% of all recycling programs or 25% of curbside programs in the state. In the United States, only about 7% of curbside recycling programs have switched to single stream (1). The recycling program in Madison, Wisconsin switched to a single stream system in 2005, and the recycling rate increased by 25% in the first year while the projected annual cost increased by only $3.00 per household (1). This leap in recycling rates suggests that implementing a single stream recycling program is one way to increase recycling rates without costing residents significantly more money, which has been suggested to be an important factor in the success of a municipal recycling program.

Drop-off and curbside recycling programs also have differing costs to the residents. To purchase a transfer station sticker for one year costs $47.17 on average in Massachusetts, while purchasing a recycling bin for curbside pickup only costs an average of $1.95. However, the average recycling rate for towns with drop-off recycling programs is actually higher (34%) than towns with curbside pickup (30%).This difference suggests that it is not only the cost of the program that leads to success. Even though residents in towns with drop-off programs have to pay more to dispose of their recycling and waste, in the end they recycle a greater percentage than those people whose recycling is picked up for them.

Although cost is not the only factor that affects the success of a recycling program, it is significant in the willingness for residents to accept and participate in a new waste management program. Massachusetts residents were asked in the survey if they would be willing to pay slightly more to improve the recycling program in their town. When asked this question, 67% of

those surveyed responded in the affirmative (Appendix A). However, when those same residents were given the definition of a PAYT recycling program and asked if they thought their town should implement one, only 20% agreed (Appendix A). These data suggest that although it is known that recycling programs are important and need to be funded, when it comes to actually implementing a program that directly costs residents money people are less willing to support it. PAYT programs in Massachusetts cost on average $52 to $78 per year per household, while buying trash bags at the super market costs only about $15 per year. In order to gather more support for changing to a pay-as-you-throw program, Kelleher suggests in her commentary about waste management and collection that the public must be educated on the benefits of this program, and have all of their concerns addressed (13).

Over the past several years, the success of municipal recycling programs throughout Massachusetts has fluctuated significantly. Figure 6 shows the average tons of recyclable material collected per town across the state from 2003 to 2008. As seen in the graph, the average amount of material recycled dropped from 1,614 tons per town in 2004 to 1,529 tons in 2006. The budget for recycling and solid waste management programs from fiscal year 2003 through 2008 is also shown in Figure 6. The budget for these types of programs in Massachusetts dropped from $3.5 million in FY 2003 to $1.97 million in FY 2005. These data suggest that the high budget in 2003 most likely played a significant part in towns being able to increase the amount of material they recycled in 2004; while the low budget in 2005 was what led to the sharp decrease in material recycled in 2006. Allocating money from the state's budget towards recycling and waste management programs is something that the state government can do to help increase the amount of material that is recycled each year. Investing money into increasing the recycling rate in a town is also beneficial for the local government. Figure 7 shows that if a town has a high recycling rate, the government earns more revenue per ton of recycled material. The average revenue in a Massachusetts town is $16.40 per ton of recyclable material collected. If the recycling rate in a town is increased to between 50-60%, this revenue increases to $17.80 per ton. A town that recycles at the average level in Massachusetts (1,483 tons per year) and has a recycling rate between 50-60% receives $2,076 per year extra revenue over the average. This increased revenue is a non-environmental incentive for states to invest money into their recycling programs. When town governments invest the recycling rate increases, therefore increasing the revenue per ton of recycled material they receive.

The collected recycling rate data can also be used to analyze recycling rate trends over time. Figure 8 shows the average recycling rates from 1997 to 2008 for the towns with the top ten and bottom ten average recycling rates. As seen in this graph, the rates for towns with higher average recycling rates have been increasing over time, while the rates for towns with lower rates have been decreasing. This pattern suggests that towns that already have successful recycling programs are continuing to focus on and improve them, while towns with less successful programs have not been able to improve them, or are not focusing on improving them. The budget for Recycling Coordination Solid Waste Management Programs and Projects in Massachusetts has decreased from 3.5 million dollars in fiscal year 2003 to 1.9 million dollars to fiscal year 2009 (14). Despite this decrease in funding, towns with high average recycling rates have still been able to increase the success of their programs over these years. This suggests that it is not solely the funding that can create a successful municipal recycling program; other factors discussed previously play a significant role. Another question posed to the residents of Massachusetts in the survey was what they thought was the most appropriate method for improving the amount of material that is recycled. Out of those surveyed, 30% said that the efforts of individual people are more important than those of the town, state, or national legislation (Appendix A). These data, along with the budget data and recycling rate trends over time, suggest that people who live in towns with higher recycling rates are more focused on their recycling efforts than those who live in towns with lower recycling rates. If the people in a town are more aware and concerned with their residential recycling program, it is more likely that they will have a successful program and a higher recycling rate.

## Conclusions

Despite the influence of several uncontrollable factors on a town's recycling program, the data suggest that there are several options for a town to improve the effectiveness of their municipal recycling program. A pay-as-you-throw recycling program was suggested to be one controllable factor that has a positive impact on a recycling program. If people are educated about the benefits of a PAYT program for recycling, there will likely be more enthusiasm for such endeavors. The fraction of the population that supports the implementation of PAYT programs can be increased from the current number of 20% (Appendix A). Single stream recycling programs are another option for towns to potentially increase their recycling rates, as shown by the study in Madison, Wisconsin where rates increased by 25% in a single year (1).

Of the Massachusetts residents surveyed, 32% thought their town could be doing more to improve their recycling program (Appendix A). While it was shown that the direct cost to residents plays a significant role in participation, it is probable that this group of people would support a change in municipal recycling programs even if it meant increasing the cost slightly. Increasing the budget for solid waste and recycling programs, which was shown to increase both recycling rate and town revenue from recycling, is another step these towns can take towards improving their recycling rates. The process of recycling paper, glass, metal, or plastic is also often cheaper than garbage disposal processes (15). The increase in recycling and decrease in garbage disposal would create a cheaper, more efficient waste management system. If every town in Massachusetts increased their recycling rate to at least 35%, the goal set by the United States EPA in 2005, over 148 thousand tons of waste would be saved from landfills every year in this one state alone.*

*Based on an average of 58.9 tons recycled per 1% recycling rate in Massachusetts from 2003 to 2008.

## Tables

**Table 1.** List of demographic and recycling program data collected for each of the 350 towns in Massachusetts.

| Town Demographic Data Collected | Town Recycling Program Data Collected |
|---|---|
| Town Name | Recycling Rate (1997-2008) |
| County | Net Increase in Recycling Rate (1997-2008) |
| Total Population | Single Stream or Dual Stream System |
| Total Households (2008) | Total Tons Recycled (2003-2008) |
| Median Income per Household (2008) | Tons Recycled per Household (2008) |
| Median Price of a Home (2008) | PAYT or Flat Rate |
| % of People over 25 with at least a Bachelor's Degree (2008) | Cost to get Recycling Bin or Transfer Sticker |
| Median Age of Population (2008) | Number of Transfer Stations per Town |
| % of Population that is Female (2008) | Revenue from Recycling (2008) |
| | Type of Recycling Service (Drop-Off, Curbside, Subscription) |

**Table 2.** Differences in demographics and recycling programs in towns with high and low average recycling rates from 1997 to 2008.

| Towns | Average Recycling Rate 1997-2008 | Average Median Income per Household 2008 | Number of Towns with PAYT Programs | Total Tons Generated per Household |
|---|---|---|---|---|
| 10 Towns with Highest Average Recycling Rates | 59% | $87,151 | 8 | 0.69 |
| 10 Towns with Lowest Average Recycling Rates | 9% | $54,535 | 1 | 0.89 |

## Figures

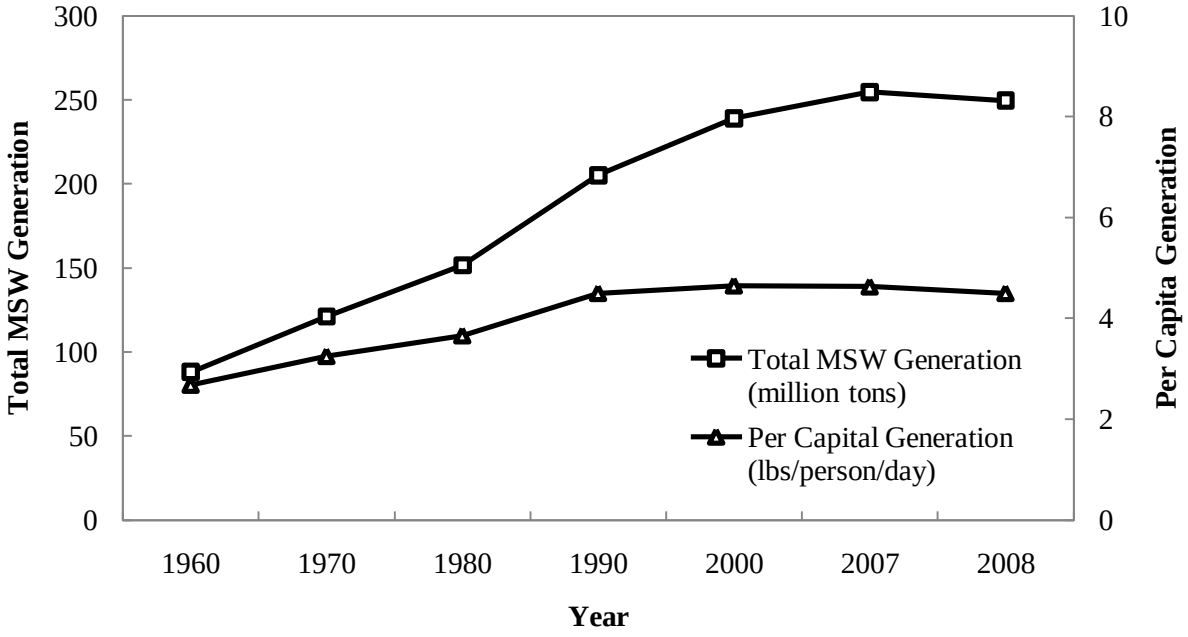



**Figure 1:** Total and per capita municipal solid waste (MSW) generation rates from 1960 to 2008. (2).

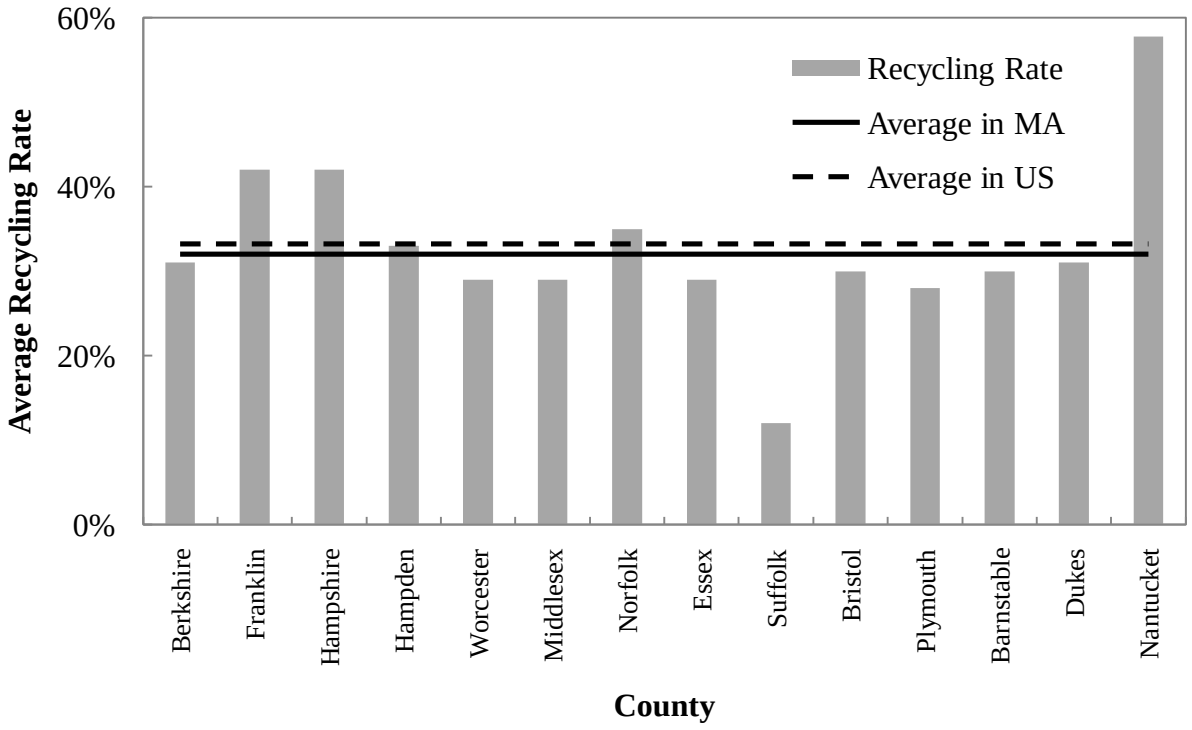



**Figure 2**: Average Recycling Rate by county from 1997 to 2008, counties ordered from west to east. Includes the average recycling rate in Massachusetts and the average recycling rate in the United States.

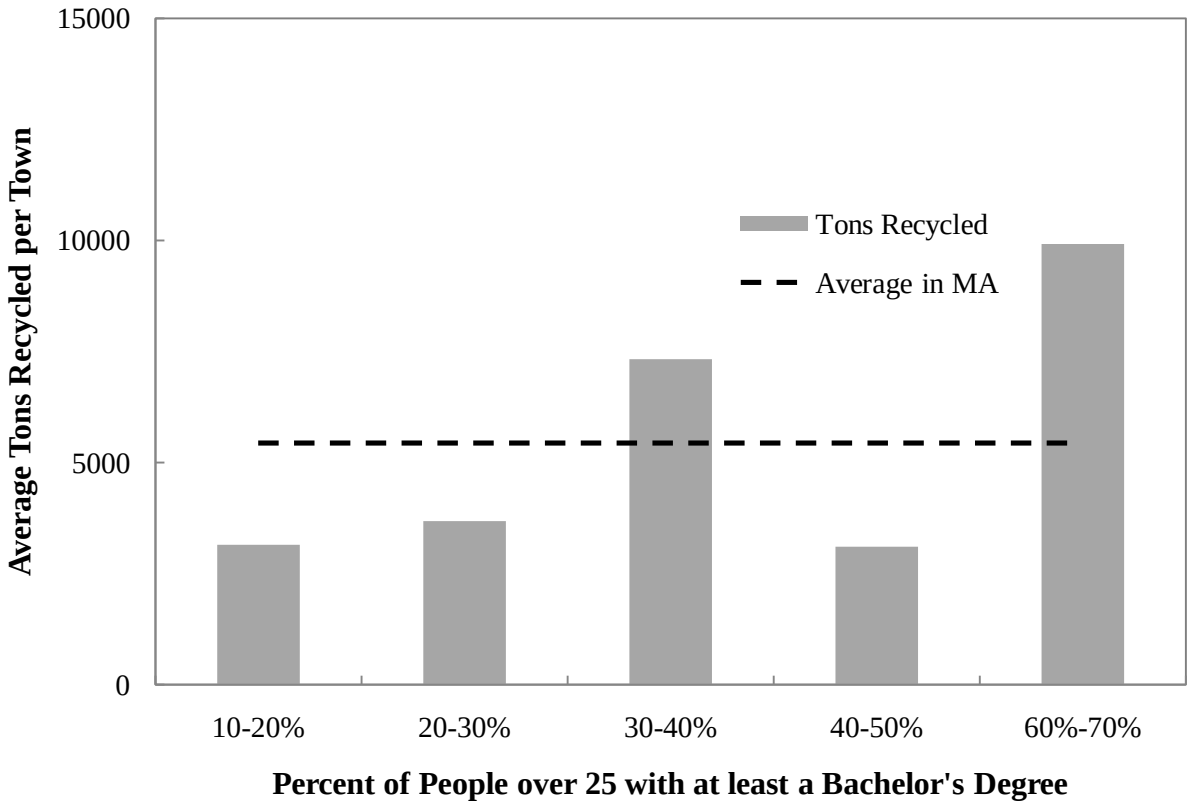



**Figure 3**: The percent of people over 25 with at least a Bachelor's degree related to the average tons recycled per town (for towns with education information available). Includes the average tons of material recycled per town in Massachusetts. No towns had education levels within 50-60%.

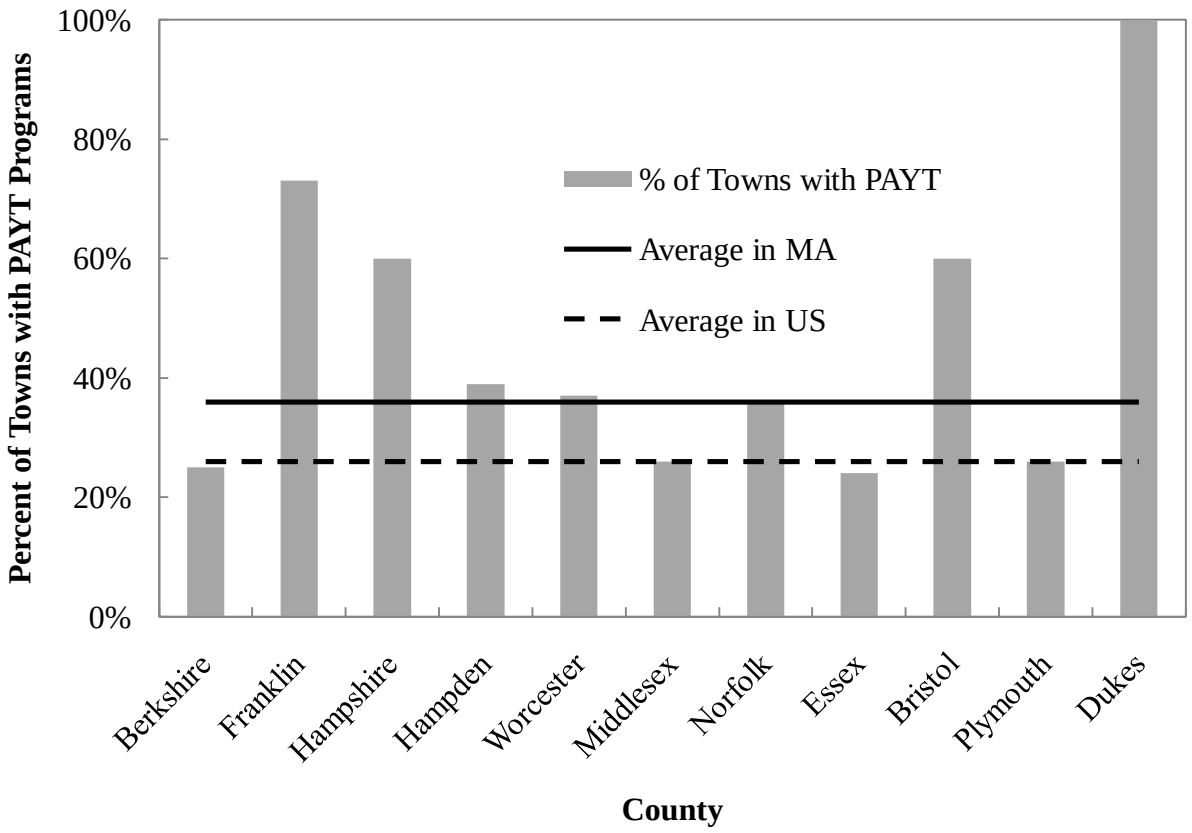



**Figure 4**: The percentage of towns in each county that have PAYT recycling programs in 2008. Counties ordered west to east, only showing counties that have towns with PAYT programs. Includes the average percent of towns in Massachusetts and the United States with PAYT programs.

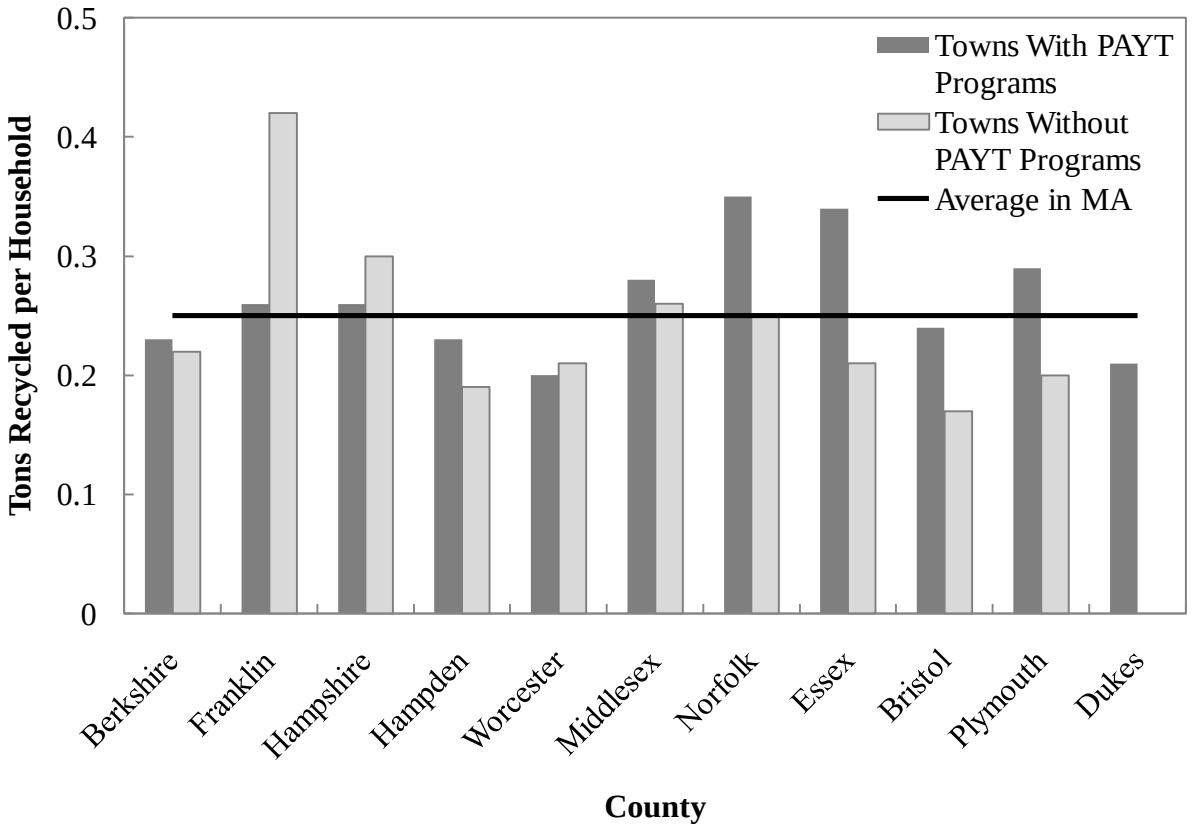



**Figure 5**: Average tons recycled per household in towns with and without PAYT programs, counties ordered west to east. Does not include counties in which no towns use PAYT programs. Includes the average tons recycled per household in Massachusetts.

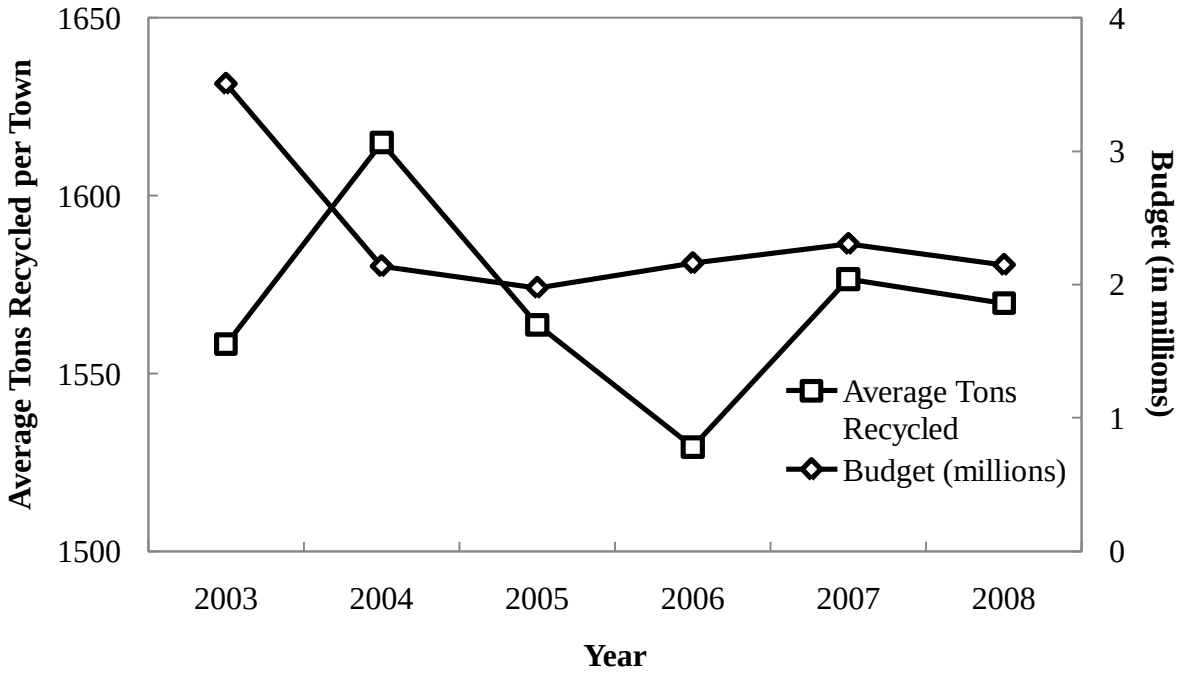



**Figure 6**: Average tons of material recycled per town in Massachusetts from 2003 to 2008 compared to the Massachusetts budget for recycling and waste management programs in FY2003 to FY2008 (16).

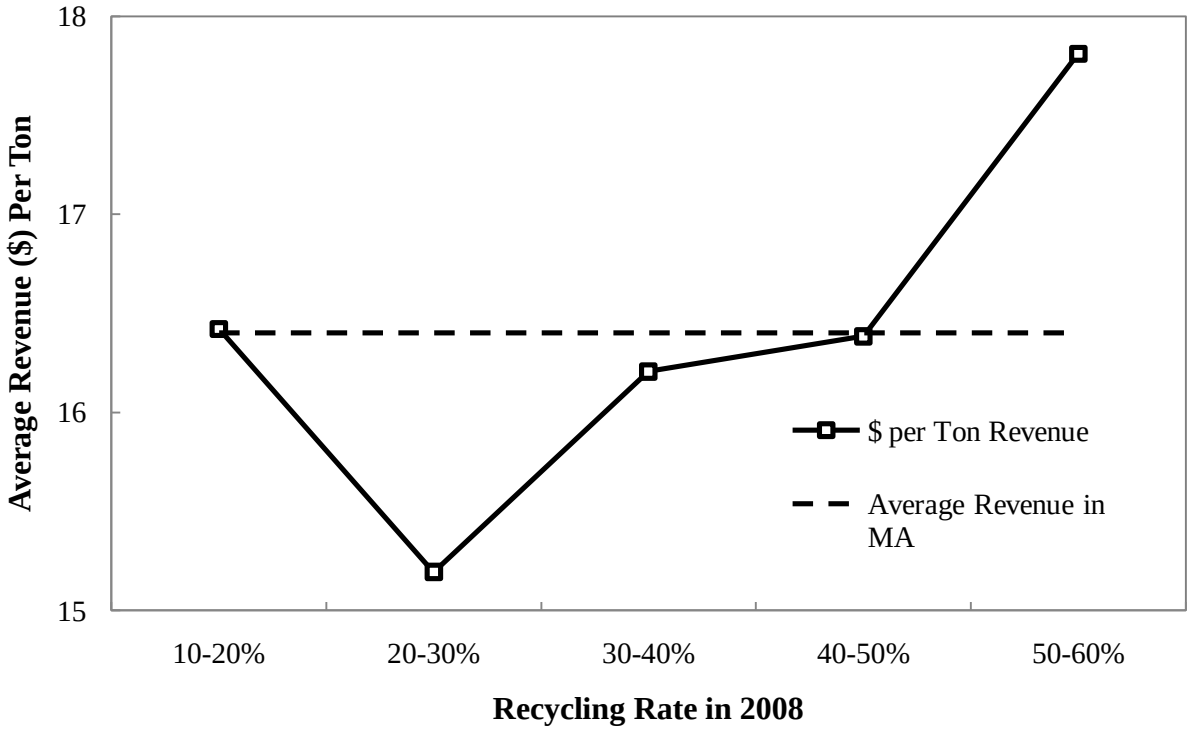



**Figure 7**: Ranges of recycling rates in 2008 compared to the average revenue in dollars per ton of recycled material collected by the individual town. Includes the average revenue per ton in Massachusetts.

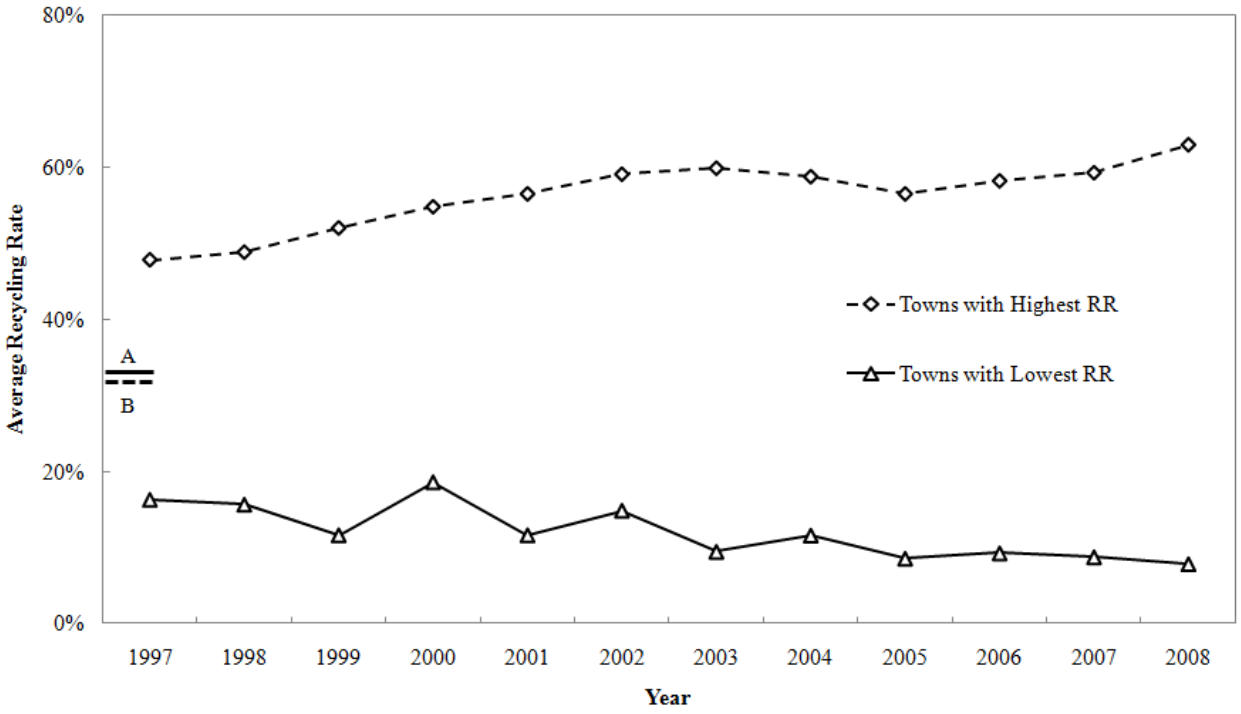



**Figure 8**: Variation of Recycling Rates (RR) from 1997 to 2008. These data are shown for towns with the ten highest average recycling rates (the lowest being 48%, highest being 63%), and the towns with the ten lowest average recycling rates (lowest being 8%, highest being 16%) in Massachusetts.
A: Average recycling rate in the United States (33.2%)
B: Average recycling rate in Massachusetts (32%)

## Appendices

**Appendix A.** Questions and responses from survey posed to Massachusetts residents about their recycling practices and their town's municipal recycling program.

**In your household, which of the following constitutes the largest amount of recyclable material?**

| | | | | | |
|---|---|---|---|---|---|
| Paper: 50% | Plastic Bottles: 29% | Plastic Bags: 3% | Soda Cans: 10% | Glass Bottles: 2% | Other: 7% |

**What is the recyclable material in your house that most often ends up in the trash instead of being recycled?**

| | | | | |
|---|---|---|---|---|
| Plastic Bottles: 12% | Glass Bottles: 6% | Paper: 39% | Cardboard: 7% | Other: 35% |

**What do you do with plastic bags and wrappers?**

| | | |
|---|---|---|
| Throw in the trash: 66% | Put with recyclable plastic: 31% | I don't know: 3% |

**Are you happy with the trash and recycling collection in your town?**

| | | | |
|---|---|---|---|
| Yes: 28% | Generally Yes: 53% | Not at all: 10% | I don't know: 9% |

**Are you happy with the efforts in your town to improve recycling practices?**

| | | |
|---|---|---|
| Definitely Yes: 20% | Mostly Yes: 48% | No, we can do more: 32% |

**If your town supplies trash bags, how much do you pay for them?**

| | | | | |
|---|---|---|---|---|
| $0.00-$0.50: 1% | $0.50-$1.00: 11% | $1.00-$1.50: 12% | $1.50-$2.00: 5% | >$2.00: 9% |

My town doesn't supply trash bags: 63%

**If your town does not have a pay-as-you-throw program, do you think one should be instituted?**

| | | |
|---|---|---|
| Yes: 20% | No: 32% | Not Sure: 48% |

**What do you think is the most appropriate method for improving the amount of material that is recycled?**

| | | | | |
|---|---|---|---|---|
| Efforts of individual people: 29% | Town Mandates: 12% | State and National Legislation: 5% | All of the above: 50% | None of the above: 3% |

**Would you be willing to pay slightly more in order to improve the recycling program in your town?**

| | |
|---|---|
| Yes: 67% | No: 33% |

**What state do you think has the best recycling practices?**

| | | | | | |
|---|---|---|---|---|---|
| I don't know: 85% | California: 4% | Connecticut: 1% | Hawaii: 2% | Maine: 1% | Massachusetts: 3% |
| New Jersey: 1% | Oregon: 1% | Rhode Island: 1% | Vermont: 1% | Washington: 1% | |

**How often do you take large items to be recycled to the designated collection centers (if available)?**

| | | | | |
|---|---|---|---|---|
| Once a month: 27% | Twice a month: 4% | More than twice a month: 8% | Never: 39% | Not available in my town: 22% |

**How many large or small trash bags do you use per week?**

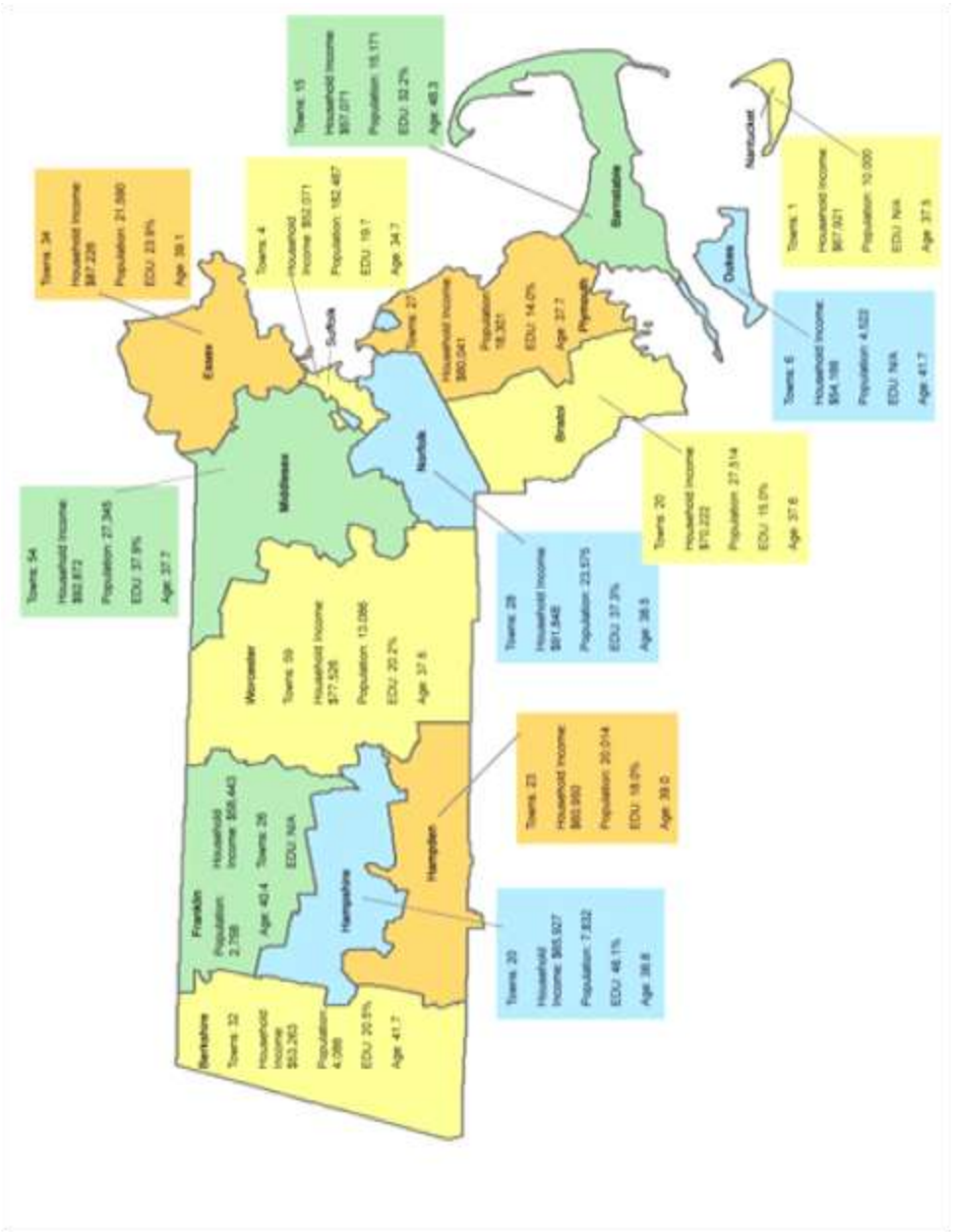
| | | | | | |
|---|---|---|---|---|---|
| 1 small: 9% | 2 small: 9% | 3 small: 4% | >3 small: 11% | 1 large: 36% | 2 large: 18% |
| 3 large: 9% | >3 large: 3% | | | | |

**Appendix B.** Equation to calculate the average tons of trash and recycling generated per household in 2008. Tons collected in each town in 2008 from Massachusetts Department of Environmental Protection.

$$\frac{Tons\ Collected\ in\ 2008}{\#\ of\ Households} = Tons\ Recycled\ per\ Household$$

$$\frac{Tons\ Recycled\ per\ Household}{Average\ Recycling\ Rate} = Average\ tons\ of\ trash\ \&\ recycling\ generated\ per\ household$$

**Appendix C.** Map of Massachusetts showing demographic data for each county. Household Income: Median household income level in 2008. EDU: The percentage of people over the age of 25 with at least a Bachelor's Degree. Towns: Number of towns in the county.



## Works Cited


1. Hutchinson, Alex. "Is Recycling Worth It? PM Investigates its Economic and Environmental Impact." *Popular Mechanics*. Hearst Communication, Inc., 13 Nov. 2008. Web. 12 Nov. 2010. <http://www.popularmechanics.com/science/environment/recycling/4291566>.
2. "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2008." *United States Environmental Protection Agency*. N.p., n.d. Web. 12 Nov. 2010. <http://www.epa.gov/osw/nonhaz/municipal/pubs/msw2008rpt.pdf>.
3. "General Recycling Questions." *MassRecycle*. Massachusetts Recycling Coalition, n.d. Web. 9 Feb. 2011. <http://www.massrecycle.org/faqs.html>.
4. "Recycling in the United States." *Wikipedia*. Web. 10 Sept. 2010. <http://en.wikipedia.org/wiki/Recycling_in_the_United_States>.
5. *City-Data.com*. 12 Sept. 2010. <http://www.city-data.com>
6. "Massachusetts." *State & County Quick Facts*. U.S. Census Bureau, 16 Aug. 2010. Web. 12 Sept. 2010. <http://quickfacts.census.gov/qfd/states/25000.html>.
7. "Waste and Recycling." *Massachusetts Department of Environmental Protection*. Mass.gov. Web. 12 Sept. 2010. <http://www.mass.gov/dep/recycle/priorities/dswmpu01.htm#recycling>.
8. *AmericanTowns.com*. 8 Sept. 2010. Web. 12 Sept. 2010. <http://www.americantowns.com/>.
9. "Price Sensitivity of Environmentally-Friendly Products." *Environmental Leader*. 23 Apr. 2008. Web. 15 Sept. 2010. <http://www.environmentalleader.com/2008/04/23/price-sensitivity-of-environmentally-friendly-products/?graph=full>.
10. Lockhart, S.M. "Factors Affecting Participation in City Recycling Programs. Ph.D. thesis. Louisiana State University and Agricultural and Mechanical College (2003). 1 Dec. 2010. http://etd.lsu.edu/docs/available/etd-0402103124721/unrestricted/Lockhart_thesis.pdf
11. Chetal, Shikha. "Recycling - Common Sense, Yet Not So Common." *Explorations: An Undergraduate Research Journal* 11 (2008): 25-36. *Undergraduate Studies*. Web. 20 Apr. 2011. <http://undergraduatestudies.ucdavis.edu/explorations/2008/recycling.pdf>.
12. "Pay-As-You-Throw." US Environmental Protection Agency, 1 Sept. 2009. Web. 29 Aug. 2010. <http://www.epa.gov/wastes/conserve/tools/payt/index.htm>.
13. Kelleher, Maria, et al. "Taking out the Trash: How to Allocate the Costs Fairly." C.D. Howe Institute Commentary 213 (2005): 1-21.
14. *Massachusetts Budget and Policy Center*. 2009. Web. 15 Sept. 2010. <http://browser.massbudget.org/ResultsTime.aspx?InflOpt=IPD>.
15. Coletta, Edmund. "Western Massachusetts Communities Earn More Than $800,000 for Recycling **in 2009, Saving $2 Million in Waste Disposal Costs**." *Massachusetts Department of Environmental Protection*. Mass.gov, 31 Mar. 2010. Web. 12 Sept. 2010. <http://www.mass.gov/dep/public/press/0310mrfs.htm>.
16. "General Recycling Questions." *MassRecycle*. Massachusetts Recycling Coalition, n.d. Web. 9 Feb. 2011. <http://www.massrecycle.org/legislation.html>.